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Review of Ethiopian Onchocerciasis Elimination (previously Control) Programme

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Abstract

Onchocerciasis is a severe parasitic infection which causes disabling skin and subcutaneous tissue changes. The disease is endemic in many African countries including Ethiopia. In 2013, Ethiopia launched Onchocerciasis elimination program with the goal of attaining interruption of onchocerciasis transmission nationwide by 2020. The country has successfully scaled up interventions and achieved 100% geographic coverage in all known endemic districts. The main strategy for interrupting the disease is mass drug administration (MDA) delivered two times per year. The treatment coverage for the last five years has been maintained at more than 80%. Despite many years of ivermectin MDA the transmission of onchocerciasis in many districts remained unabated. To achieve the 2020 goal, sustained high geographic and therapeutic coverage is required which is validated by coverage surveys. The programme should aim to improve the knowledge and attitude of the community towards the programme in order to improve drug compliance. The partnership between the relevant stakeholders should be strengthened to facilitate open discussions regarding the programme implementation and any challenges that may arise in the control and elimination of the disease. It is also important to consider intensified vector control.

Background

Onchocerciasis (river blindness) is one of the debilitating neglected tropical diseases (NTDs)[1] that have drawn the attention of national governments, non-governmental organizations, pharmaceutical companies, philanthropists and health development practitioners worldwide. Onchocerciasis is an eye and skin disease caused by filarial worm called *Onchocerca volvulus*, which is transmitted by the bite of an infected black fly, of the genus *Simulium*[1]. These flies breed in fast-flowing streams and rivers, hence the name “river blindness.” People with infections can experience severe itching, dermatitis, eye lesions, and/or subcutaneous nodules[1]. In most of the endemic countries, blindness is inevitable for those with severe and chronic infections, though this is not the case in Ethiopia[1,2]. The disease is one of the underlying causes of poverty amongst the communities where it is prevalent. The socio-economic implications of onchocerciasis are significant as the disease impacts on the lives of individuals and communities in endemic countries[1].

Worldwide there are 120 million people at risk of onchocerciasis, of which 96% are in Africa[3]. . In parts of Africa, the disabling consequences of onchocerciasis led to migration of people away from fertile riverine land, and the disease still constitutes an obstacle to development in certain areas where disease control measures have not yet been fully implemented[4,5]. According to the World Health Organization (WHO), 6.5 million people who have the disease suffer from dermatologic manifestations and 270,000 are blind[3].

In Ethiopia more than 17 million people live in the surveyed endemic areas of Ethiopia and are affected by the disease, or are at risk of infection. Studies conducted so far in Ethiopia indicated that the disease is mostly found in South-Western, Western and North-Western parts of the country[6].

Ethiopia launched onchocerciasis elimination programme with the goal of attaining the interruption of onchocerciasis transmission nationwide by 2020[6]. This manuscript describes the onchocerciasis elimination programme in Ethiopia with emphasis on the milestones, and lessons learnt through the implementation of the programme.

Burden, epidemiology and geographical distribution of onchocerciasis in Ethiopia

In Ethiopia, the disease has been known since 1939 following investigations by Italian researchers in South-Western Ethiopia[7]. It is a disease of public health and socio-economic importance in the country and is endemic in 188 districts with an estimated 17 million people at

risk of the disease (Table 1) [6]. In 2013, onchocerciasis was responsible for 34,600 disability-adjusted life-years (DALYs) lost [8]. The main symptom of the disease is dermal manifestations that are characterized by intense itching and thickening of the skin, hanging groin and depigmentation of the skin[9]. In a study conducted on Ethiopian immigrants living in Israel, the most common clinical manifestation found was chronic papular onchodermatitis, found in more than 46 patients (55%); with depigmentation and atrophy found in 13 (15%) and 12 (14%) of the study participants; respectively[10].

The western part of Ethiopia, where many rivers with vegetation provide a suitable habitat for the vector, was found to be endemic for onchocerciasis following rapid epidemiological mapping of onchocerciasis (REMO) (Figure 1)[6]. In these mapped areas, the prevalence of onchocerciasis is highest in places that are close to rivers, with the prevalence dropping gradually as one moves further away from the rivers[6]. The central highlands and arid lowlands of Ethiopia are generally thought to be free of onchocerciasis, most likely due to the highlands low temperature and the lowlands absence of fast flowing rivers, dry weather and lack of suitable vegetation, which are unsuitable environments for both the vector and the parasite[6]. However, mapping of onchocerciasis in the eastern part of the country was not done due to lack of historical evidence and presumed ecological unsuitability for transmission. Parts of regional states of Amhara, Oromia, Southern Nations, Nationalities and Peoples, and Gambella and all districts of Benishangul-Gumuz region are known to be endemic for onchocerciasis[2,6].

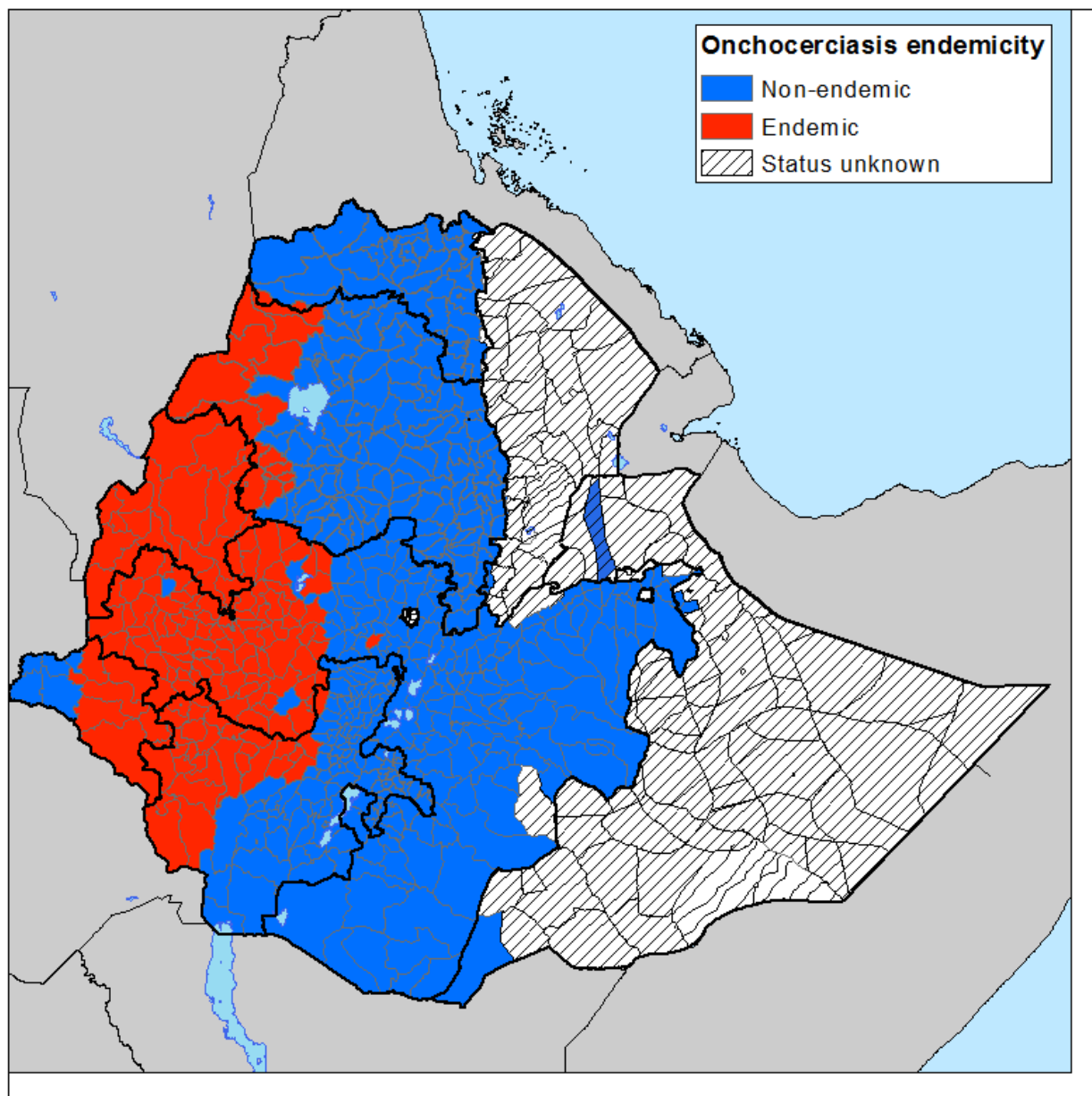


Figure 1: Onchocerciasis endemic districts in Ethiopia (2015)

Table 1 Distribution of onchocerciasis by region	
Region	No of endemic districts
Oromia	105
Amhara	19
SNNPR	35
Gambella	8
Benishangul gumuz	21
Total	188

Lymphatic filariasis (LF) is a parasitic disease that is transmitted by mosquitoes, clulex and ades. It causes elephantiasis. Onchocerciasis and LF have overlapping endemicity in many parts of Africa and Ethiopia is no exception. There is also an LF elimination effort in Ethiopia (with a similar national goal of transmission interruption by 2020) and both elimination programmes use ivermectin MDA (in LF MDA, ivermectin is combined with albendazole, donated by GSK). Coordination of onchocerciasis and LF elimination efforts is essential in foci where co-endemicity exists so that elimination of both diseases can be achieved in an integrated fashion, especially regarding transmission assessments. In Ethiopia, there are 45 co-endemic districts (Table 2).

Table 2: Distribution of onchocerciasis and LF co-endemic districts in Ethiopia	
Region	Number of co-endemic districts
Oromiya	9
SNNPR	10
BSG	13
Amhara	6
Gambella	7
Total	45

Socio-economic impact

Beyond the debilitating health burden, onchocerciasis also inflicts tremendous social and economic damage on individuals and entire communities. In a case-control study conducted to determine the effect of non-blinding onchocerciasis on work productivity at Baya farm in Teppi coffee plantation project; cases had a significantly lower total household income and lower average per capita income. Cases were significantly more likely to be absent from their work due to illness and unauthorized leave than controls and, furthermore, controls earned a 25.2%

increase over the salary earned than cases and spent a larger proportion of their income on health costs[11].

Evolution of NTDs program

Few years ago NTDs were not given the required attention at various levels. Although disease specific interventions exist, there were no coordinated NTD interventions in Ethiopia. Data on the burden and distribution of NTDs were incomplete; access to preventive and curative services were inadequate and not well integrated. Thus, NTDs continued to debilitate, deform, blind and kill sizeable proportions of the population either as mono-infections or as co-infections with major killers such as HIV/AIDS. Cognizant of this, Ethiopia launched the first NTD masterplan in May 2013 and the second version in 2016[6,12]. NTDs were also included in the country's 5-year Health Sector Transformation Plan (HSTP)[13].

Programme Implementation

The first REMO was conducted in 2000-2001 and MDA was launched in 2001 in the then Kafa-Sheka Zone. Since 2012, the country has been implementing onchocerciasis elimination strategies in all endemic districts. Preventive chemotherapy using MDA is the main intervention strategy. MDA is conducted by community drug distributors through the health development army. Health education is one of the strategies to raise the awareness of the communities and mobilize them before and during MDA (Figure 9). Out of 188 endemic districts, 184 are eligible for bi-annual treatment based on the criteria set by the Ethiopian Onchocerciasis Elimination Expert Advisory Committee (EOEEAC) in 2014 to ensure interruption of onchocerciasis transmission by 2020. Enlisted below is summary timeline of historical data:

- First REMO conducted in 2000 - 2001
- Onchocerciasis MDA was launched in 2001 in the then Kafa-Sheka Zone
- The first skin snip survey was conducted in Kafa-Sheka and Bench Maji Zones and treatment with Ivermectin was started in 2001
- TDs Masterplan launched in 2013
- Entomological survey commenced in 2013 and expanded to all endemic and suspected areas /zones.
- The first three black fly collection sites were selected and established in 2013, in Jimma, Shaka and Bench Maji zones.

- EOEAC was established in October 2014.
- Onchocerciasis elimination guideline was launched in October 2015.
- Onchocerciasis molecular laboratory established at Ethiopian Public Health Institute in October 2015

Mass drug administration (MDA) process

The health development army are responsible for distributing the medication to eligible individuals. The approach used in most of the communities includes training sessions prior to each activity. It all starts with zonal-level ‘training of trainers’ which is then followed by district-level training of HEWs before the first semiannual MDA for each year. This training is then shortly cascaded to health development army. This high level of community ownership has helped to create required level of community awareness and overcome the challenges imposed due to inadequate MDA coverage. Training for community leaders is conducted to sensitize and educate them about onchocerciasis, including how to organize the MDA. Training sessions on health communication are also organized in each community and focus on a number of key messages related to onchocerciasis treatment, transmission, and prevention, as well as the clinical manifestations of onchocerciasis. Training is followed by an intense community mobilization campaign using available media including banners, posters, audio spots on local radio stations, and messages delivered by megaphones to inform and encourage the population to participate in the MDA. Different types of posters have been distributed to each village and posted in a range of places to increase visibility. Community mobilization and sensitization is also conducted by health extension workers and the health development army at each village using existing opportunities such as social and religious gatherings and local market places where people are gathered. The community elders and the community administration, as well as the community at large are key players in facilitating the MDA activities. Finally, following the distribution, reported coverage data aggregated by age and gender is collected from each distribution post to the respective districts then rolls up to zonal health departments, regional health bureaus and finally submitted to the Federal Ministry of Health (FMOH).

Mass Drug Administration (MDA) Progress

Onchocerciasis MDA in Ethiopia was started in 2001 in the then Kefa-Sheka Zone with the support of APOC (African Programme for Onchocerciasis Control). The prevalence of skin nodules was used to initiate MDA. Since then, the treatment has expanded and scaled up to all known endemic districts and now there are about 14 million people in 188 districts under

ivermectin treatment each year. The reported MDA coverage has gradually increased since then and the latest for 2015/6 was 81% (Figure 2). The mass drug administration has been extended to work force in development scheme with regular support through supervision and review meeting.

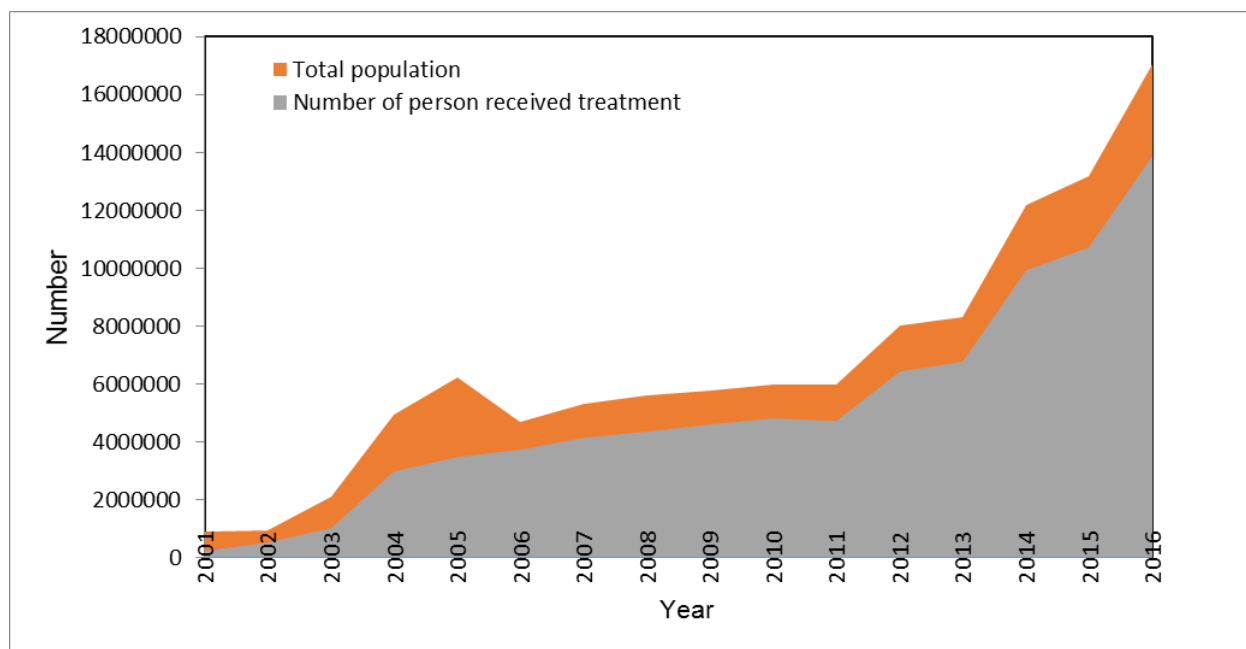


Figure 2: Trends in onchocerciasis treatment since 2001

Four times a year treatment

Four times a year MDA for onchocerciasis has shown great impact to interrupt transmission in Latin America[14]. In line with WHO's recommendation Ethiopia has set an ambitious goal to interrupt onchocerciasis transmission by 2020. However, with mapping not completed in some areas and treatment over ten years having not interrupted transmission in many districts of the country, the need to shift gear it is essential to change gears from twice a year treatment to four times a year treatment. This is particularly important in areas where the health system is performing very well, where transmission is still ongoing following impact assessments, and in newly identified endemic districts to speed-up the elimination.

Integrated NTD program

Five preventive chemotherapy (PC)-NTDs (trachoma, onchocerciasis, lymphatic filariasis, schistosomiasis and STH) are common in Ethiopia, majority of them are co-endemic in the same districts. PC is being used as one of the main strategy to eliminate and control majority of

NTDs in Ethiopia. There is insufficient funding and technical assistance that can aid the MOH to carry out these programs throughout the country. The scale up of intervention is being compromised by inappropriate utilization of resources. This has enforced the implementation of cost-efficient NTD control programs where disease-specific programs are integrated and coordinated by the trainings, logistic distribution, social mobilization and monitoring activities. This is believed to link the programs effectively with other elements of the health system. Onchocerciasis is not an exception from these integrations. The onchocerciasis elimination strategies have been included in the integrated refresher training manual for HEWs. Indicator for onchocerciasis mass drug administration has been included in the health management information system.

Monitoring and Evaluation

The monitoring and evaluation of the onchocerciasis programme involves coverage surveys, epidemiological, parasitological and entomological assessments. The coverage surveys are conducted in selected districts to validate programme coverage. The epidemiological and parasitological assessments are usually conducted after 10 rounds of treatment and they are supplemented with entomological surveys. In Ethiopia so far, we report complete geographic coverage in all known endemic districts and therapeutic coverage has reached 81 percent of the total population. Impact assessment conducted using epidemiologic, parasitological and entomologic assessments showed that there are districts with ongoing transmission that can maintain endemicity in the absence of MDA. The onchocerciasis flag prepared at the end of 2016 to monitor the progress of the programme, indicated that there were no districts in Ethiopia that have declared interruption of transmission. However, there are two districts in North Gondar that have been found to be negative for all impact assessments but their closeness to endemic districts with ongoing transmission makes it difficult to declare them as having interrupted transmission of onchocerciasis (Table 3).

Table 3: Impact assessment results from North Gondar			
District	Year MDA started	No of treatment rounds	No of positive pool/total pool
Metema	2003	15	2/68
Quara	2003	15	2/145
Tach Armacho	2004	14	0/2
West Armacho	2004	14	0/93

In Tepi, South-Western Ethiopia, a study was conducted to assess the status of onchocerciasis after four years of annual community directed treatment with ivermectin (CDTI) and the result indicated that 69 (25.5%) individuals age >10 years were found to be positive for microfilaremia and the microfilarial load of the positive individuals ranged from 0.08 – 8mf (mean 1.3) per gm of skin snip which was significantly lower than prevalence (81%) and intensity of infection (0- 855, mean 33 ± 5.6) reported before the initiation of the CDTI programme in the study area[15]. In another study conducted in Anfilo district, Kelem Wollega Zone, Western Ethiopia, after six successive years of annual ivermectin mass treatment the prevalence of microfilaria reduced from the pre-intervention value of 74.8% to 40.7%, indicating a 45.6% reduction, mean intensity from 32.1(SD=61.5) mf/mg skin snip to 18.7(SD=28.7) indicating a 41.75% reduction, CMFL from 19.6 mf/mg skin snip to 4.7 indicating a 76% reduction. There was a statistically significant difference this reduction ($P < 0.05$)[16]. These results also showed that the prevalence of microfilaria and mean intensity decreased as the number of treatment taken increased (Figure 3&4).

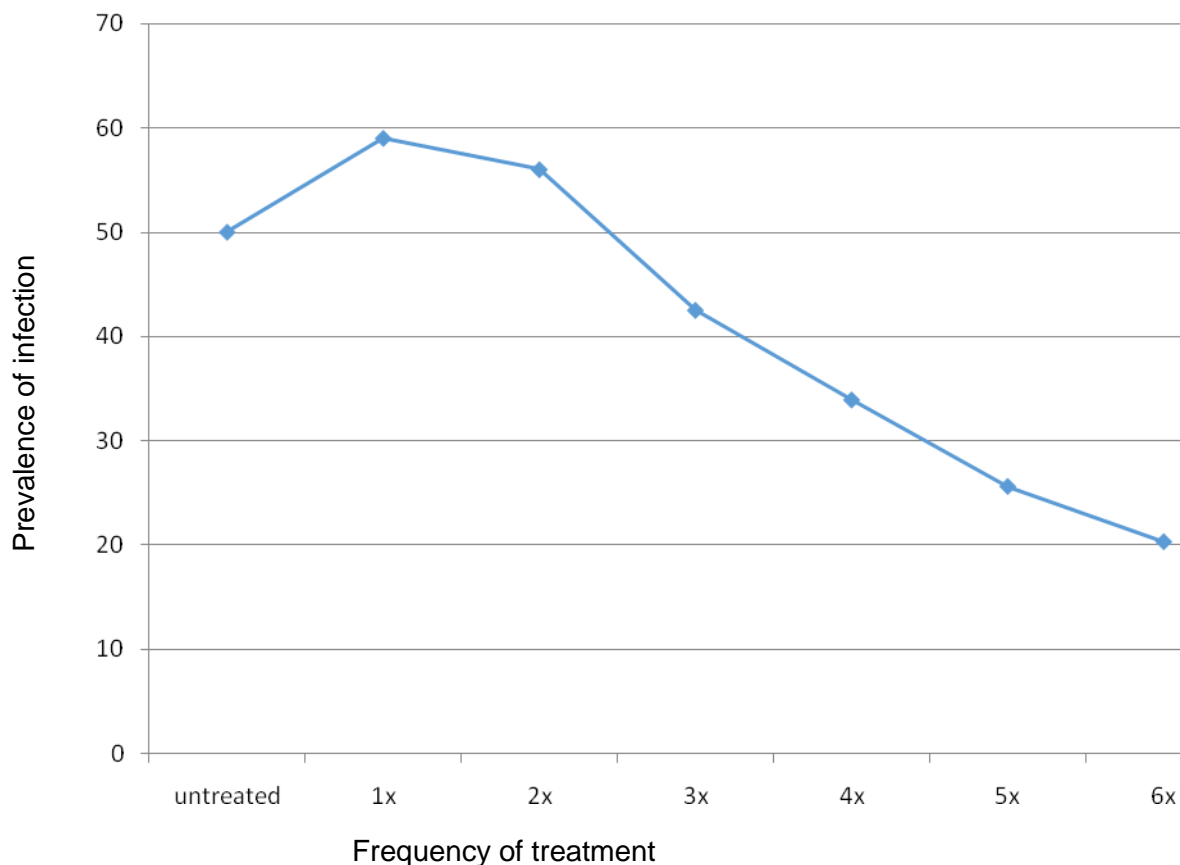


Figure1. Prevalence of infection versus frequency of treatment, in Anfilo district, Kelem Wollega

Zone, Western Ethiopia, April 2012

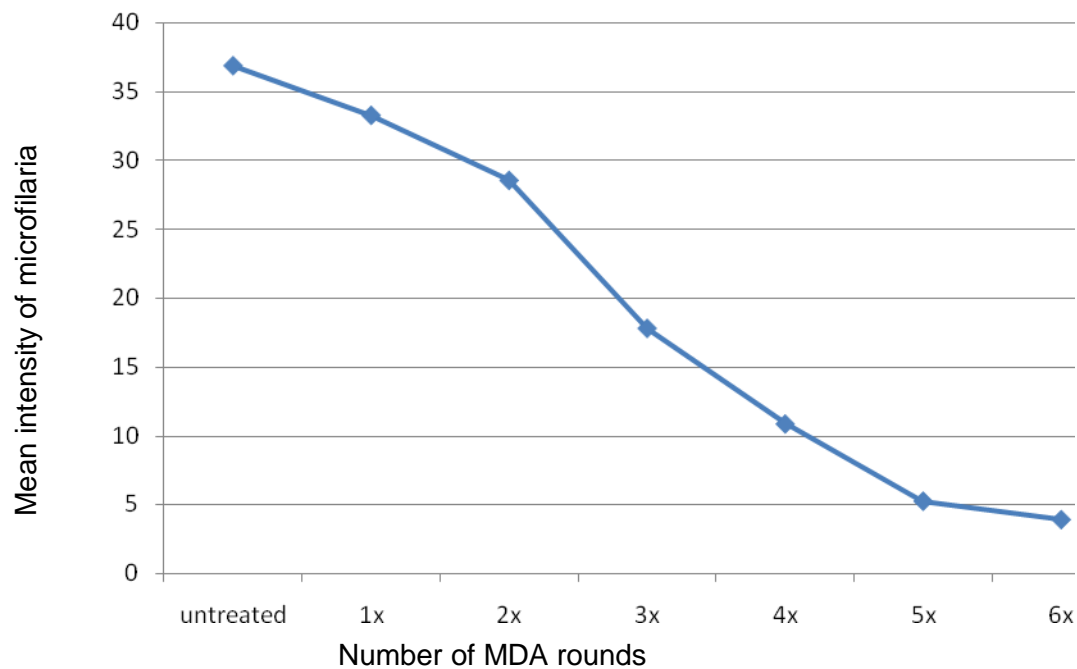


Figure 2. Number of MDA given versus mean intensity of infection, Anfilo District, Kelem Wollega Zone, February – April, 2012

Entomological assessment

Fly collection site has been established in different part of the country with the objective to confirm transmission interruption and monitor intra and inter border transmission. The entomological assessment is also important to decide cessation of MDA in transmission zones and it is directly supervised by Ethiopian Public Health Institute (EPHI).

Cross-border collaboration

Onchocerciasis transmission zones appear to cross the border between the Sudan, the Republic of South Sudan (RSS), and Ethiopia. In addition, there is continuous movement of people who are possibly infected among these countries. The programme has initiated cross border activity with Sudan and started collaborative work to determine the existence of cross border transmission and to improve surveillance of cross border transmission.

Partnership

The FMOH provides overall policy direction, coordinates and creates an enabling environment so that stakeholders and partners can contribute to the country's efforts towards achieving the envisaged elimination goal by 2020. The FMOH has used the increasing interest from donors

and pharmaceutical companies to manage the agenda of onchocerciasis elimination and through fruitful discussions with developmental partners, has laid out the way for technical and financial support. Over the past many years, Ethiopian Onchocerciasis Elimination Programme enjoyed the generous support from WHO/APOC (World Health Organization/African Programme for Onchocerciasis Control), MDP (Mectizan Donation Program) and NGDOs (Non-Governmental Development Organizations). The partnership has helped the effort to scale-up onchocerciasis elimination interventions in all known endemic districts of the country.

The FMOH also established the EOEAC with the objective of soliciting technical advice from high-level experts on onchocerciasis elimination. This advisory committee is composed of national and international experts, as well as FMOH staff from all endemic regions of Ethiopia. The committee reviews annual progress made by the onchocerciasis elimination programme and provides recommendation to update the Ethiopian 'onchocerciasis flag', which will be a visual table, color-coded by focus according to the four stages of elimination depicted in the WHO guidelines. Furthermore, the committee recommends altering or halting interventions. In addition, a national onchocerciasis Technical Working Group (TWG) has been established which is composed of stakeholders, implementing partners, research and teaching institutes. The TWG, under the auspices of the National NTD Taskforce (NNTF) advises the FMOH on strategic issues.

The main partners that support the onchocerciasis elimination programme in Ethiopia are The Carter Center (TCC), Research Triangle Institute (RTI) and Light for the World (LTW). TCC support 112 districts in Oromia, Amhara, SNNPR, Gambella and Benishangul. RTI supports 14 districts in Benishangul-gumuz and LTW supports 64 districts in Oromia (Figure 5). Moreover, WHO provided technical and financial support for the national delineation survey for onchocerciasis transmission and entomological surveys for programme evaluation. The Ethiopian Public Health Institute (EPHI) with support of WHO/APOC has played a prominent role in the onchocerciasis mapping in most parts of the country. Other universities and research institutions help to fill gaps on the transmission dynamics of the disease, not only by gathering and disseminating new knowledge from elsewhere, but also by undertaking small and large-scale studies in different parts of the country.

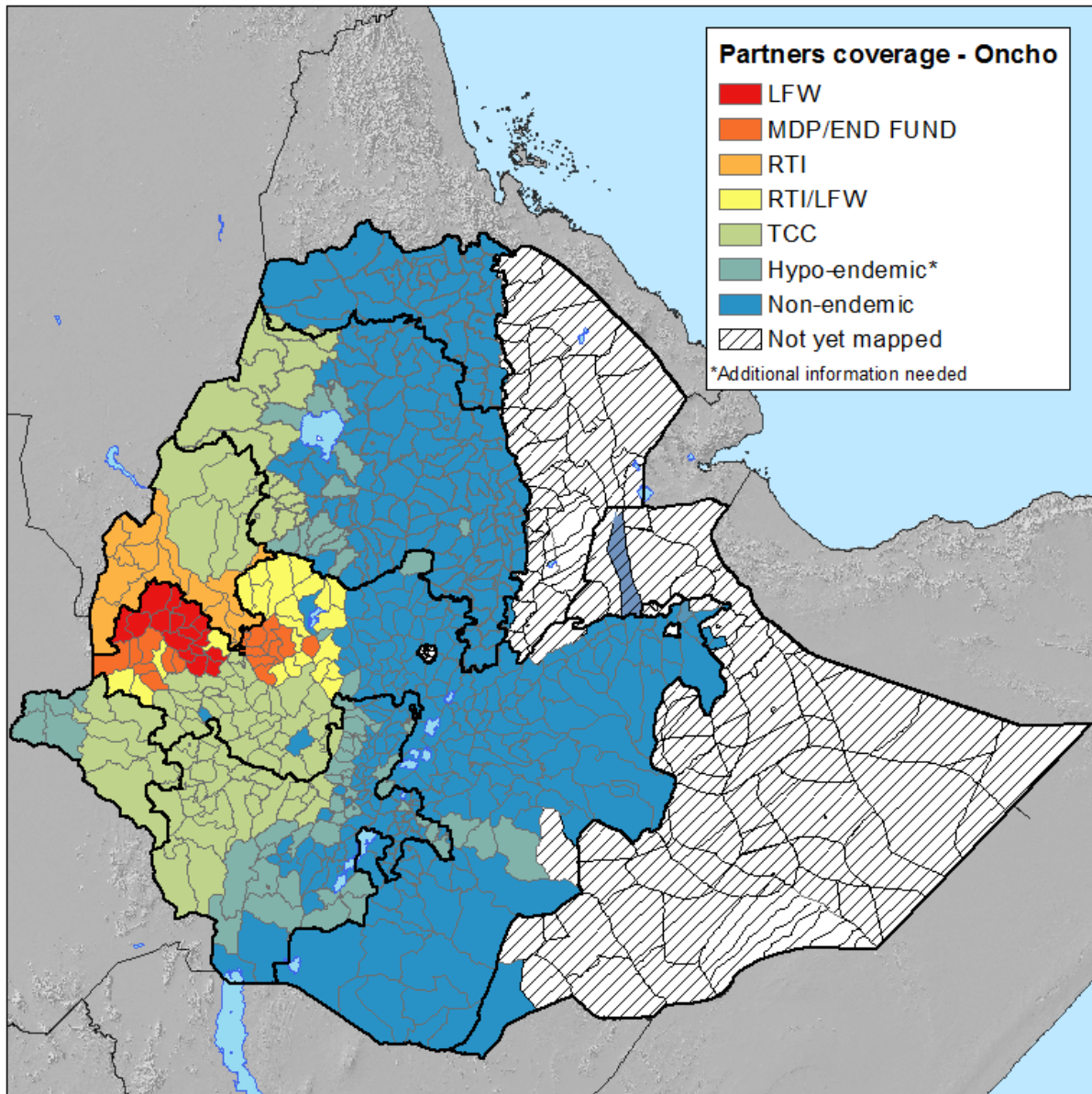


Figure 5. Partners map of onchocerciasis

Major programme implementation challenges towards onchocerciasis elimination

Mapping has been completed for most of the country but there are still some areas in the eastern part which require mapping and there are also a few areas in the western part which require additional information to enable evidence based decisions making on the need for intervention. Although experts have differing perspectives on the need for mapping in the eastern part of the country due to ecologic factors that do not favor the disease transmission, it is considered important to assess the whole country to be successfully verified for

onchocerciasis elimination. The absence of regular coverage surveys to validate programme reports and failure to reduce the disease prevalence below the minimum threshold level after many years of MDA might pose potential challenges including refusal by the communities to take ivermectin during MDA, staff demotivation, drug resistance, donor fatigue and resultant uncertainty of drug donations. Lack of well documented activities, reports and data at all level could also affect the verification process once onchocerciasis is eliminated.

Conclusion

Ethiopia envisaged to interrupt onchocerciasis transmission by 2020 and to be certified free from onchocerciasis by 2025. This goal requires strong programme implementation and monitoring in collaboration with developmental partners. There should be full geographic coverage and above the minimum recommended therapeutic coverage. In order to ensure that high MDA coverage is maintained MDA coverage surveys have to be carried out on regular basis. The programme should aim to improve communities' active involvement in the selection of community drug distributors, determination of sites for MDA and provide locally appropriate incentives (monetary and non-monetary) to the CDDs. Health workers and CDDs should put concerted effort to enhance knowledge of the communities on the disease, adherence to MDA and attitude towards the programme in endemic districts so as to increase MDA coverage and expedite interruption of onchocerciasis transmission. Furthermore, it is essential to improve capacity at all levels to ensure proper programme management. The partnership between all relevant stakeholders should be strengthened to facilitate open discussions around the programme and allow knowledge transfer to accelerate control and elimination of the disease. The country should consider other feasible interventions, such as vector control/elimination when and where applicable.

Competing interests

We declare that we have no conflicts of interest.

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